# RESEARCH HIGHLIGHT

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Technical Series 04-125

## RESIDENTIAL SOURCES OF LEAD

### INTRODUCTION

Lead is a contaminant that can be found in various locations around the house—in the water, house dust, old paint, etc. All house occupants can be affected by lead exposure, but young children are often the most susceptible. High levels of body lead, usually indicated by blood lead levels, may lead to intellectual impairment as well as anemia, stomach cramps and other physical symptoms. The blood lead levels of Canadians have been falling for the last 20-30 years, due in part to the phasing-out of leaded gasoline, but there are still individuals whose lead levels are too high.

Recent state legislation in the U.S. targeted lead-based paint as being a major source of household exposure to lead. There have been very few lead exposure studies in Canada, and it is unclear whether lead in paint would be a major factor in personal lead exposure in Canadian housing.

In 1993, the City of Saint John, New Brunswick found that several residents had high blood lead levels. Drinking water was suspected as a major source of exposure. The City commissioned a study of 500 houses and their occupants, and the level of lead in the drinking water was compared to the blood lead levels of the residents. Canada Mortgage and Housing Corporation (CMHC) saw this as a good opportunity to look at lead sources in housing, and investigated a subsample of 100 of these houses: 50 houses with occupants having relatively high blood lead levels, and 50 houses with occupants having amongst the lowest blood lead levels. The research objective was to compare the houses of these two groups and to see whether the variation in occupants' blood leads levels could be attributed to housing factors.

### RESEARCH PROGRAM

To identify major sources of household lead, the following factors were investigated.

- Lead in blood: venous blood samples collected and analyzed in the 500 house project funded by the City. A "high lead level house" had all occupants with elevated blood leads; a "low lead level house" was inhabited only by occupants with low blood lead levels.
- Lead in water: flushed water collected during the 500 house study
- Lead in paint: X-ray fluorescence (XRF) analysis in several locations about the house, including wall, ceiling and trim paint
- Lead in soil: two soil samples per house collected to a depth of 2-3 cm in areas preferentially from exposed soil, a play area or vegetable garden
- Lead in dust: two or more samples per house using an air pump and filter protocol adopted from testing in the Trail, B.C. Lead Project
- Lead in food: a rough composite sample that included food from all refrigerator, freezer, cupboard and stored items

The results were correlated statistically to determine which factors were most responsible for occupants having high blood lead levels.

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## FINDINGS

The data clearly showed that the blood lead levels in the Saint John sample were related to the levels of lead in the tap water. Using only water lead levels to predict whether residents would be in the high versus low blood lead group would provide the right answer 85 per cent of the time. Note that most Canadian residents will not see this level of lead in water, as one of the Saint John water supplies was unusually acidic.

In general, the high blood lead group were older and lived in older houses. No house built later than 1955 had a high water lead level. This may be due on one hand to the presence of lead service pipes; on the other hand it may be due to the reservoir feeding the newer houses in the sample.

Lead in paint levels were higher in houses with high blood lead levels, with a mean value of 0.7 mg/cm$^2$ versus 0.3 mg/cm$^2$ for low blood lead houses. Each group had individual paint lead samples that exceeded 10 mg/cm$^2$. See Figures 1 and 2 below.

Figure 1: Low Blood Lead Houses

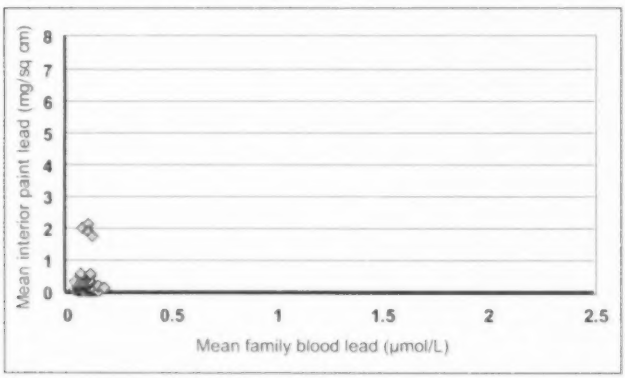
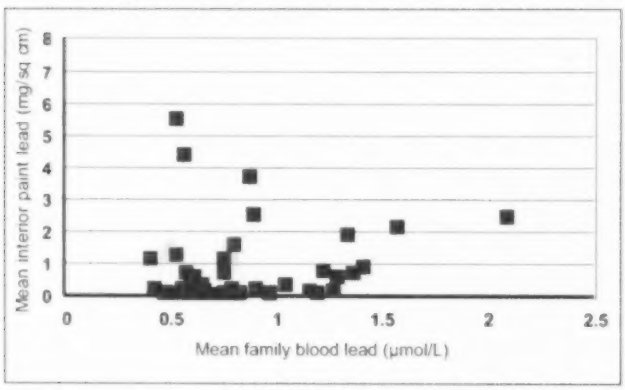



Figure 2: High Blood Lead Houses




Soil lead levels ranged from negligible values to 2,700 parts per million (ppm), but mean levels were quite low. Low blood lead houses typically had soil lead levels about 30 ppm; high blood lead level houses were higher at about 75 ppm. These are in the range of soil leads in other Canadian cities and below various international guidelines recommending maximum lead concentrations of 200-500 ppm in soil.

The lead in dust measurements are for the concentration of lead in the dust, rather than the amount of lead per unit of floor space (the lead "loading"). The concentration of lead in the dust of high blood lead houses was typically twice the concentration of the dust in the low blood lead houses. There was a strong trend in both groups of houses to have the concentration of lead increase as sampling progressed from the entranceway to the bedroom. See Table 1 below for arithmetic means.

Table 1

| Rooms | Dust in low blood lead houses (ppm) | Dust in high blood lead houses (ppm) |
|---|---|---|
| Entry | 28 | 56 |
| Living | 54 | 91 |
| Bedroom | 180 | 459 |

Lead in the food of Saint John residents contained a comparable amount of lead to the food sampled in other Canadian studies. The slightly higher levels may be due to different collection measures and the use of leaded water in food preparation. Again, there were higher concentrations of lead found in the food of high blood lead houses than in the low blood lead houses.

A statistician analyzed the various factors and concluded that the lead in water was the most accurate predictor of the occupant's blood lead, in this sample of Saint John houses. The high blood lead houses generally showed higher concentrations of lead in all factors: water, soil, dust, paint, and food. However, if the water lead levels exceeded 15 µg/L, the household almost certainly belonged to the high blood lead group.

As mentioned, the variables were not independent. Older houses tended to have older soils with higher lead levels, higher lead in water levels, and more lead in the house paint. Older occupants had higher blood lead levels and tended to live in older houses. None of the children tested had high blood lead levels. The study size did not allow a more detailed analysis to attribute the proportion of the lead intake to each factor measured.

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## IMPLICATIONS FOR CANADIANS

The intent of this study was to examine the different pathways for lead exposure in Canadian houses. The difficulty in using the Saint John sample of people and houses is that the lead in water concentrations were high enough to mask the relatively small effects caused by the other factors.

Blood lead levels in children during the 1960s or 1970s were typically several times higher than blood lead levels seen today. Now, measured blood lead levels of Canadians are typically 30-50 per cent of blood lead guidelines of approximately 10 µg/dL or 0.48 µmol/L. It takes an unusual circumstance—high local water leads, a child prone to pica (eating dirt or paint), lead exposure at work, or a dusty renovation of an older home and its inherent dust—to put individuals at risk.

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**Research Report:** Residential Sources of Lead

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**Housing Research at CMHC**

Under Part IX of the *National Housing Act*, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

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